Pilot Program Report

Site Planning and Facility Maintenance Management

at Lawrence Livermore National Laboratory

UCRL-AR-154598

This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-48.

August 2003

UCRL-AR-154598

Responsible Manager
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Introduction

During the 1990s, the Department of Energy (DOE) established that the facilities and infrastructure (F&I) of the DOE Weapons Complex were aging and not well maintained. Due to a lack of effective investment, conditions were declining. Following the formation of the National Nuclear Security Administration (NNSA) in 1999, DOE/NNSA placed a high priority on quantifying and correcting historical F&I neglect within the Nuclear Weapons Complex. In FY 2001, NNSA presented the Defense Programs Facility and Infrastructure Assessment to the House Energy and Water Development Committee as a first step to define the Facility Management Plan to halt and correct the deterioration within the complex.

To provide clear expectations, identifying and correcting deferred maintenance were a primary focus. *Deferred maintenance* is "maintenance that was not performed when it should have been or was scheduled to be and which, therefore, is put off or delayed for a future period."

At the Deferred Maintenance Reduction Summit of 25 July 2002, NNSA NA-52 established a clear commitment by NNSA Headquarters and each field site, both federal and M&O contractor, to the NNSA corporate goals of deferred-maintenance reduction. Those goals are as follows:

- *By the end of FY 2005, NNSA will stabilize its deferred maintenance.*
- *By the end of FY 2009, NNSA will*
  - —*Aggressively reduce deferred maintenance to within industry standards*
  - —*Return our facility conditions, for our programmatic facilities and specific other important infrastructure at a minimum, to an assessment level of "good to excellent"*
  - —*Have institutionalized responsible and accountable facility management processes, including budgetary ones, so that the condition of NNSA facilities and infrastructure is maintained equal to or better than industry standards*

Under the leadership of the House Committee on Energy and Water, the NNSA Facility and Infrastructure Recapitalization Program (FIRP) was funded to achieve these goals. Within the FY 2002 language, NNSA was to initiate pilot projects in the areas of successful site planning and cost-effective maintenance management. The goal of the pilot projects is to provide models to improve F&I management practices within DOE.

In the spring of 2003, the DOE Office of Engineering and Construction Management (OECM) requested the NNSA Laboratory Site Operations Office at Lawrence Livermore National Laboratory (LLNL) to work with the Laboratory to document its Facility Management and Reinvestment Program. This report summarizes the processes, practices, and top-level accomplishments of LLNL's ten-year effort to continuously improve its site and facility management program to better support the Laboratory's national-security mission. More details, as well as specific plans and accomplishments, are documented in the Ten Year Comprehensive Site Plan submitted annually to DOE/NNSA.

Background

Lawrence Livermore National Laboratory recently passed the half-century mark since its beginnings in 1952, and the Laboratory's aging F&I are undergoing revitalization, recapitalization, and renewal. At Livermore, we have met the NNSA FY 2005 goal of stabilizing backlog growth and are on track to attain our goal, mandated by NNSA, of meeting industry maintenance standards by the end of FY 2009. Our ability to advance to this goal is a result of several years of analyzing difficult institutional issues and developing tools and work processes to manage this undertaking efficiently and effectively.

About seven years ago, Livermore conducted the Cost Cutting Initiative (CCI), a yearlong reengineering project to establish effective infrastructure management processes by integrating dialogue, tools, incentives, management processes, and controls to ensure success. CCI resulted in an overhead reduction of more than 25%. From these savings, about $8M[1] of seed funding was provided to improve the quality of Laboratory facilities.

The benefits of this reengineering project were synthesized with those of several other initiatives and led to the evolution of an effective management process. This process has provided Livermore with a better understanding of the critical measures for making a facility management system work. After a significant effort, growth in the backlog has been stabilized through the Laboratory's innovative Facility Management and Reinvestment Program. Table 1 summarizes the key process elements of this program.

Extending this process to move from stabilization to significant backlog reduction was made possible by the DOE/NNSA Facility and Infrastructure Recapitalization Program. FIRP is a corporate initiative to make significant improvements in F&I, thereby enabling NNSA and the Laboratory to better meet their national-security missions.

[1]All costs are stated in burdened dollars, except the Laboratory facility charge (LFC), which is stated as an unburdened rate.

Table 1. Key elements of a successful site planning and maintenance management program.

Leadership

- Senior management who are committed to safe, cost-effective, and mission-responsive facility management
- An independent champion who strategically manages the institutional facility investment portfolio and facilitates action for beneficial change to normalize rankings and maintain the integrity of the maintenance process
- Knowledgeable facility "owners" who assure safe operation of their real-property systems and understand the operational requirements of these systems
- A culture that encourages constructive innovation and enhanced productivity

Partnership

- Independent programmatic and facility management chains with defined roles, responsibilities, and authorities for programmatic, real-property, and associated facilities and systems
- Active and effective dialogue and planning between programmatic and facility management teams to identify the facility investments required to support new mission capabilities or to modify existing facility assets to accommodate changes in facility requirements
- A working partnership between the M&O contractor and its sponsoring agency

Planning and Controls

- Efficient space-management processes:
  —to manage excess space in a safe and cost-effective manner
  —to clean up and demolish substandard facilities with environmentally and economically sound processes
  —to establish an equitable space tax as an incentive to use space efficiently
- Processes and procedures (e.g., DOE orders) that facilitate the use of the safest, most efficient, and most cost-effective tools and methods to achieve the performance required by the mission
- Integrated external and self-assessment processes to provide feedback and improve planning and controls
- A valid process and system for assessing facility conditions

Execution

- Centralized expertise to execute a well-integrated maintenance management program
- An integrated model with transparent metrics to track and evaluate actual progress and to project the expected gains from future investments
- Aggressive resource management to establish budgets, track funding, and evaluate results
- Systems to identify all real-property assets, evaluate their mission importance, and determine their reliability or probability of failure
- Well-integrated processes to capture and prioritize all the elements that make up the total facility investment and management portfolio

Developing a System That Works

During the last decade, Livermore has made accountable, cost-effective facility management an important element of its institutional culture. Integrating the key elements of the management program shown in Table 1 into routine work has led to a set of work processes that work well at the Laboratory. A summary of these work processes follows:

- A formalized burden structure was established to track and better manage the operational costs of program management, personnel, and facilities.
- Business and management processes were developed to understand the total operating budget and the relative balance between funding for the technical mission and for infrastructure support.
- A process and system were developed for assessing facility conditions and documenting deferred maintenance. LLNL worked with DOE to pilot the concept of the condition assessment survey (CAS) and the condition assessment information system (CAIS).
- The position of institutional facilities manager (IFM), a senior manager who reports to the deputy director, was created to strategically manage the Laboratory's facility investment portfolio and facilitate improvements in the facility management process.
- A continuously improving, well-prioritized, real-property maintenance program with a conscious, visible goal of minimizing negative impacts to the Laboratory's critical missions was developed and executed to ensure that any occurrences of untimely failures or lack of reliability are rare events. At Livermore, this process is centralized in and managed by the Plant Engineering organization.

The results have been significant. The maintenance reinvestment funds have grown to almost $13M annually, due to productivity improvements that were stimulated by the initial seed funding. The Laboratory facility charge (LFC), which was adjusted in FY 1998 to provide the initial reinvestment funding, has remained constant in annually inflated dollars. By FY 2002, growth in the maintenance backlog had been stabilized, and during the last five years, projected high-priority, mission-critical maintenance has been well-defined and performed each year. In FY 2003, the total cost of the remaining backlog that has accumulated over the years is about $318M. Although not all of this work will—or should—be done, most of the remaining deficiencies will most likely become important in the next ten years.

Internally available funds are inadequate to effectively manage a problem this large. DOE/NNSA's recognition that unmanageable backlogs are a complex-wide problem led to the creation of the Facility and Infrastructure Recapitalization Program. This visionary initiative is committed to restoring and reestablishing world-class status to the Weapons Complex by FY 2009. Many of the tools, processes, and models discussed here can be adapted to make FIRP goals a reality throughout the DOE/NNSA complex.

Good Tools and Wise Investments Evolve into "Promising Practices"

The steps taken by Laboratory managers to stabilize Livermore's maintenance backlog have stemmed the deterioration of infrastructure such as roofs; heating, ventilation, and air conditioning (HVAC) systems; and boilers. These successes led the Government Accounting Office (GAO) to cite the Laboratory's "most promising practices" for real-property maintenance and to offer those practices as an example for other federal facilities (GAO/NSIAD-99-100 [September 1999]).

These practices include the following:

Establish a single system for counting and categorizing real-property inventory.
In collaboration with DOE, Livermore has adopted and supported the facility information management system (FIMS) to identify, characterize, and report all real-property data. This system captures required and actual maintenance each year. An example of a FIMS data sheet is shown in Figure 1.

Have a single, valid, engineering-based system for assessing facility conditions, with adequately trained personnel and multiple levels of review.
The master equipment list captures all real-property assets and associated equipment in all Laboratory facilities. Expert technical personnel evaluate each asset or system to establish its condition and projected reliability. This evaluation, the CAS, examines one-third of Laboratory assets every year. The CAS captures all deficient assets, adds new deficiencies, and tracks completed corrections (see Figure 2). LLNL has been working as a partner with DOE Headquarters since 1991 to develop and pilot CAS/CAIS. The process and system that were developed have been extremely useful maintenance management tools for the Laboratory. Facility managers receive CAS reports annually for each of their facilities to ensure their concurrence with the reports. (See Appendix A for several other examples of CAS reports available to Plant Engineering and facility operators.)

Currently, the total number of deficiencies in the CAS is about 12,000 (captured in 1500 pages of evaluation sheets). Users review the data for each facility to establish the mission importance of each deficient system or component, and Plant Engineering estimates the probability of the unit's failure. In collaboration with the IFM, Plant Engineering ranks each deficiency for funding priority. Figure 3 illustrates the outcome of the initial ranking process in 1998. From this process, about 10% of the total backlog was identified for short-term correction. The annual update identifies 250–350 high-priority projects that are to be funded and corrected in the following year and projects the maintenance requirements for the following two years.

(FIMS 01)

U.S. Department of Energy
Facilities Information Management System

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05/19/2003

Complete Owned Building Report

Field Office 14 Oakland Ops | **Site** 14002 Lawrence Livermore National Lab | **Area** 001 All

Property	Property		Usage Description	*Alternate Name*	Excess Ind / Year
111	**DIRECTORS OFFICE**	101	**Office**	**GRABOSKE, HAROLD C**	**No**

Initial Acquisition Cost:	$3,401,789	Complies with	Y	Year Built:	1969
Total Improvement	$8,184,342	UFAS Exemption:		Year Acquired:	1969
Replacement Value:	$30,458,655 (Contractor Value)	UFAS Justification:		Summary Condition:	Good
FIS Asset Type:	Buildings	Building Status:	Operating		
FIS Reporting Source:	Lawrence Livermore National Lab	Status Date:	06/01/1969		
		Transfer to PSO:		Deferred Maint	$940,111
Outgrant Indicator:	N				
		Status Utilization:	100%	Inspection Date:	12/03/2001
No of Floors Below Grade:	0	HQ Program	NNSA	FCI:	3.09%
No of Floors:	8			Annual Reqd Maint:	$365,559
No of Buildings:	1	Land Ownership:	Owned By DOE	Annual Actual	$285,535
Gross SQFT:	105,448			Availability %:	
Net Occup	69,468			Failure Rate	
Energy Consuming Building/Facilities:	0			Failure Rate Standby:	
Energy Consuming Industrial and Lab:	105,448				
Energy Consuming Metered Proc	0				
Non-Energy Consuming Bldg/Facilities:	0	Seismic Essential:	P1		
Meters: None		Seismic	Fully Rehabilitated		
EMS4 Site: 1403		Seismic			
Deficiency:	Electrical Systems				
	Plumbing Systems				
	HVAC Systems	Design Use:	Office		
	Exterior Closure	Historic	Not Evaluated		
	Interior Finishes and Construction				
		Occupants Ind:	Y		

Model Bldg: Concrete Frame with Infill Shear Walls
Hazard Category: Not Applicable
Notes: 10/2/00 SAFETY DOCUMENT UPDATED- SCR 7/28/00
4/3/00 HISTORY/ USE POPULATED

OCCUPANTS:

Occupant Type:	Occupant Name:	No of
Contractor	LLNL	275
Other	VARIOUS	7

Figure 1. A sample facility information management system (FIMS) data sheet that summarizes each structure's primary characteristics and evaluations in a consistent and uniform format. The fields captured by FIMS are updated quarterly. Each year, the actual versus planned maintenance expenditures are recorded and compared with the replacement plant value to establish each building's condition.

AD
MAHLER, JENS P

ADFM Ranking Status Report (FY-03)

ADFM
MORROW, VALERIE L

Rank	PRI	POF	Asset	Defic. #	Deficiency Type Description	Opt Yr	Quantity	Est Cost	Current Status	Type of $/Approved ☐
B	1	M	**231** ROOM 1324	105842	PANELBOARD; 480V; 225-399A;20-36CKT	1985	1 EACH	$7,602 E.# 516A6	Working Year: 2002	Type of $: FIRP / ☑
B	1	M	**231** ROOM 2300	105642	XFMR; 15 KVA; 120-480V SEC; 1/3 PH	1985	1 EACH	$4,962 E.# 0062TB	Year:	Type of $: / ☐
B	1	M	**231** ROOM	18629	Fan;AC&AirHndlng;AxFlo;15000-28000CFM	2002	1 EACH	$26,958 E.# 231FS01	Year:	Type of $: / ☐
B	1	M	**231** ROOM 2300	20308	Fan;UtilSet;StlConst;BDrv; 2900-3600CFM	2005	1 EACH	$2,885 E.# 231FS15-A16	Working Year: 2002	Type of $: FIRP / ☑
B	1	M	**321** ROOM 1437	207138	Fan;Cent;RfVent;BD;Plstc;250-3810CFM	1985	1 EACH	$7,835 E.# 321FHE14	Planned Year: 2003	Type of $: Line Item / ☑
B	1	M	**321** ROOM 1437	207141	Fan;Cent;RfVent;BD;Plstc;250-3810CFM	1985	1 EACH	$7,835 E.# 321FHE15	Planned Year: 2003	Type of $: Line Item / ☑
B	1	M	**321** ROOM 1437	207143	Fan;Cent;RfVent;BD;Plstc;250-3810CFM	1985	1 EACH	$7,835 E.# 321FHE16	Planned Year: 2003	Type of $: Line Item / ☑
B	1	M	**322** ROOF OVER RM. 109	10932	Fan;Cent;RfEx;BDr;1660-2800CFM;12-40"D HOUSING SHOWS SEVERE CORROSION.	1985	1 EACH	$2,905 E.# 322FHE02	Year:	Type of $: / ☐
B	1	M	**322** ROOF OVER RM. 109	10933	Fan;Cent;RfEx;BDr;1660-2800CFM;12-40"D HOUSING SHOWS SEVERE CORROSION	1985	1 EACH	$2,905 E.# 322FHE03	Year:	Type of $: / ☐
B	1	M	**322** ROOF OVER RM. 109	424986	Fan;Cent;RfVent;BD;Plstc;250-3810CFM	1995	1 EACH	$7,835 E.# 322FHE01	Year:	Type of $: / ☐
B	1	M	**322** ROOM 100	424990	Fan;Cent;RfVent;BD;Plstc;250-3810CFM	1995	1 EACH	$7,835 E.# 322FHE05	Year:	Type of $: / ☐
B	2	H+	**231** ROOM 1201	370503	Boilr,SldFl;Stm&Htw; 7200-13000MBH	1998	1 EACH	$167,163 E.# 231BHW02-A	Year:	Type of $: / ☐
B	2	H+	**231** ROOM 1201	370505	Boilr,SldFl;Stm&Htw; 7200-13000MBH	1998	1 EACH	$167,163 E.# 231BHW01-A	Year:	Type of $: / ☐

02-Jun-03

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Figure 2. A sample page of backlog maintenance deficiencies. Each deficiency is identified by building, system, and replaceable component. The optimum year for replacement and the associated cost are determined from lifetime data and an operational evaluation. Ranking, prioritization, and current status are also shown.

Figure 3. Each year, Livermore's condition assessment survey (CAS) captures about 12,000 deficiencies in approximately 1500 pages. These deficiencies are prioritized to determine the essential backlog, and the 250–350 most important deficiencies are organized into projects for correction.

Prioritize budget allocations based on physical condition, relevance of facilities to the mission, and life-cycle costs and budgets.

CAS reports are used each year by Plant Engineering, the IFM, and facility managers to rank the mission impacts of potential asset failures, the probability of failure, and any other factors that could impact the Laboratory’s mission. The input from this joint evaluation is used to rank deficiencies on a scale from A to F and to prioritize all available funds for deficiency correction (see Figures 4 and 5).

- Essential backlog goals:
  - A projects are the highest priority and are corrected as soon as possible.
  - B projects are corrected in less than a year.
  - C projects are corrected within three years.
- D and E projects are observed and may migrate over time into the essential backlog.
- F projects, typically associated with excess facilities waiting for demolition funding, are funded only if correction is required to prevent an environmental or safety problem. (This process is summarized in the Laboratory’s *FY03 Ten Year Comprehensive Site Plan* [Appendix A, LLNL Facilities Management Case Study.])

At the end of the fiscal year, the CAS captures the total maintenance backlog, which lists all maintenance deficiencies that have not been funded historically because of a lack of funds. Since 1998, approximately 20% of the annual LFC funding has been applied to maintenance reinvestment (backlog reduction). This level of internal investment has stabilized Livermore’s maintenance backlog at $318M in FY 2003 dollars.

Charge an annual maintenance fee, based on the amount of square feet used, to ensure adequate funding for facilities and to create an incentive for space conservation.

The Maintenance Management Program derives its funds from a single annual fixed cost, the LFC, per gross square foot of facility space. This cost is charged to each facility occupant. In FY 2003, the LFC rate is $7.97 per square foot to maintain approximately 6.9M gross square feet of facilities, including maintenance reinvestment and pre-D&D cleanup of contaminated legacy facilities. This tax matches the level of work required to maintain and operate the Laboratory’s real property without creating unintended negative impacts on programmatic work. The tax is also high enough to provide an incentive for facility owners to use space efficiently.

Facilities managed under Readiness in Technical Base and Facilities (RTBF) funding pay this same space charge for real-property maintenance. In FY 2002, RTBF paid $3.84M in LFC charges.

Space that is no longer needed can be returned to the institution after all programmatic equipment and hazards have been removed by the occupant program. Useful space is generally reassigned; excess space that will not be reassigned is managed under a surveillance and maintenance plan. When most maintenance functions have

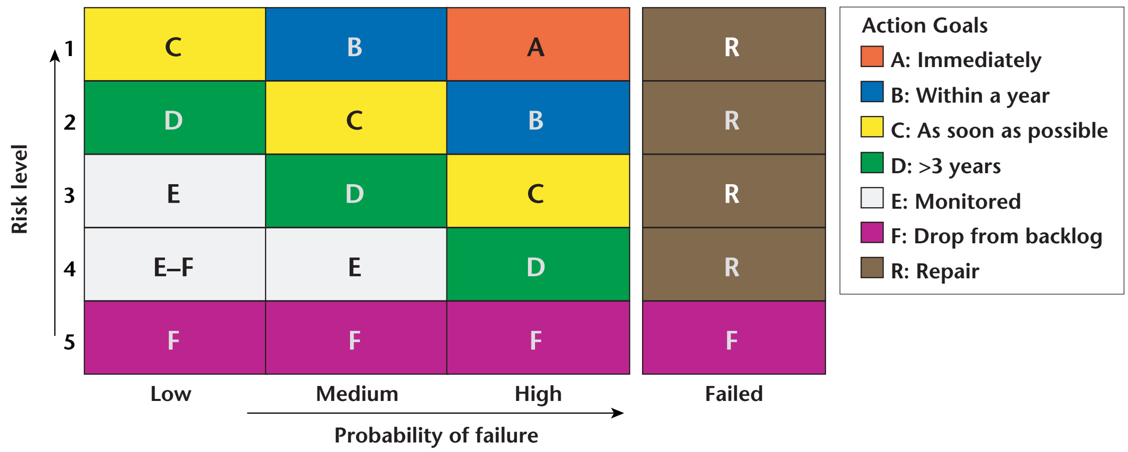


Figure 4. A mission impact–probability of failure matrix used by Plant Engineering and facility operators to rank the funding priority of each deficiency. The IFM office integrates the ranking, resolves any conflicts, and tracks the budget and schedule for reinvestment funds. The prioritization process culls the critical maintenance requirements (i.e., the essential backlog), which are about 20% of the total. As described in the body of this report, the goal is to quickly correct the most important elements of the essential backlog and address the entire essential backlog within a three-year window.

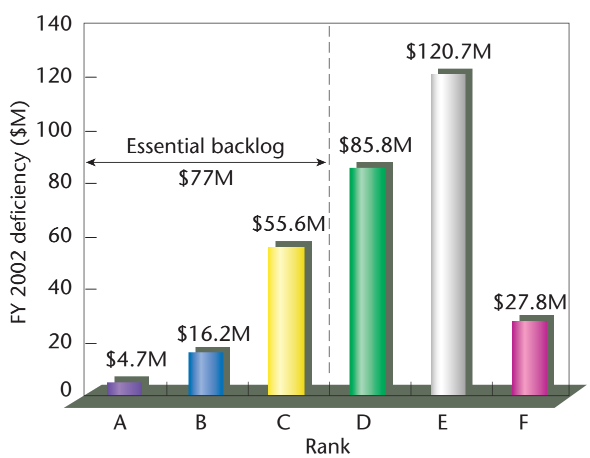


Figure 5. The condition assessment survey backlog for FY 2002 illustrates the distribution of maintenance priorities and the application of all sources of funding. Maintenance reinvestment has stabilized the total backlog. As can be seen in Figure 9a, funding from the Facility and Infrastructure Recapitalization Program is reducing the total backlog.

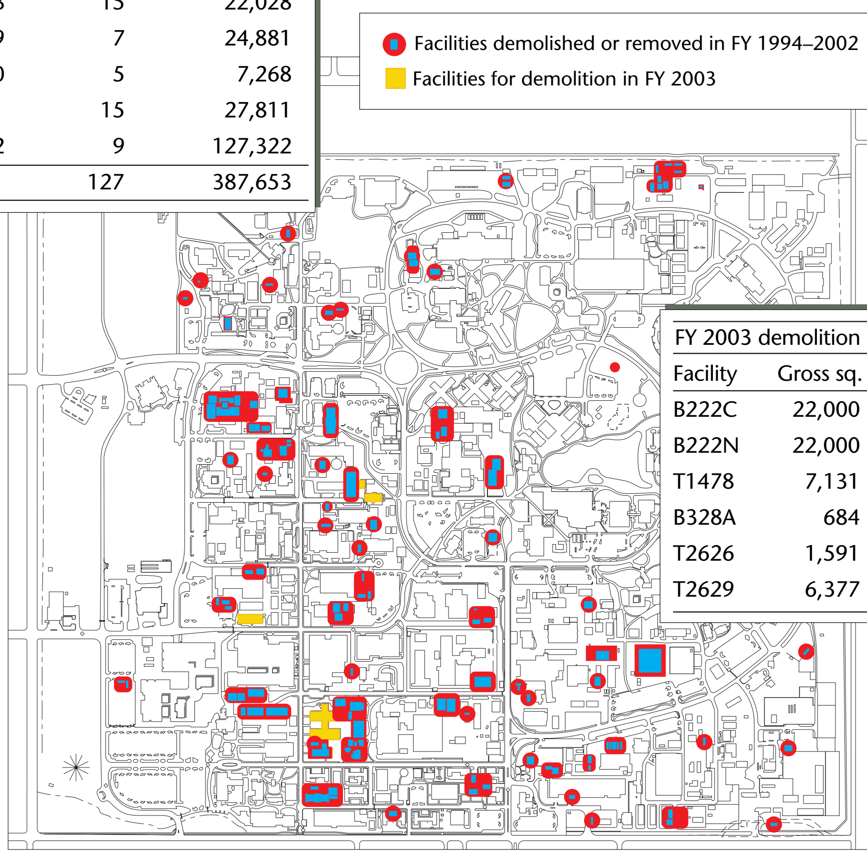
been terminated, the space tax is reduced to 40% of the LFC until the building is demolished. Any maintenance required to maintain environment, safety, and health requirements is then paid by the institution—a process that is managed by the IFM office for the institution.

As of FY 2003, over 500,000 square feet of surplus facilities have been returned to the institution for reassignment or demolition. Planned demolitions started in 1994, and to date, almost 400,000 square feet have been demolished.

Within the projected FIRP funding plan, the Laboratory expects to demolish most of its present and expected excess facilities by FY 2011. Success in this plan will reduce costs and risks while providing new building sites without increasing square footage, consistent with NNSA goals for footprint reduction (see Figure 6).

Summary data: FY 1994 through FY 2002

Year	Facilities	Gross sq. ft.
FY 1994	8	27,907
FY 1995	9	5,467
FY 1996	46	116,832
FY 1997	13	28,137
FY 1998	15	22,028
FY 1999	7	24,881
FY 2000	5	7,268
FY 2001	15	27,811
FY 2002	9	127,322
Total	127	387,653



FY 2003 demolition plans (as of 3/03)

Facility	Gross sq. ft.	Status
B222C	22,000	Planned
B222N	22,000	Planned
T1478	7,131	Planned
B328A	684	Planned
T2626	1,591	Planned
T2629	6,377	Planned

Figure 6. Managing aging and excess facilities requires an aggressive demolition effort. This map illustrates the demolition of about 400,000 square feet of facilities since 1994 and the planned demolitions in FY 2003 of about 60,000 square feet. Many of the later demolitions have been older, concrete facilities with a history of handling hazardous materials.

Set up a single real-property maintenance budget that is controlled by a central office with the power to shift resources to facilities in the greatest need. LFC maintenance indirect funds are restricted to the maintenance and operations of real property.

Plant Engineering applies the LFC funds to maintain all real-property buildings and to operate associated infrastructure assets. (High-voltage systems are one exception; their maintenance costs are covered by the customer recharge for electric power.) The LFC is managed by Plant Engineering in collaboration with customers and the IFM office. This centralized management structure ensures that the LFC and all other available funds are used to correct the highest priority, mission-significant problems (see Figure 7). The LFC tax is levied on space used by any and all Laboratory programs, independent of the programmatic office; therefore, real-property maintenance costs and benefits are distributed equitably on the basis of need and use.

The maintenance of programmatic equipment is generally covered in RTBF or other direct funding and does not compete with real-property maintenance.

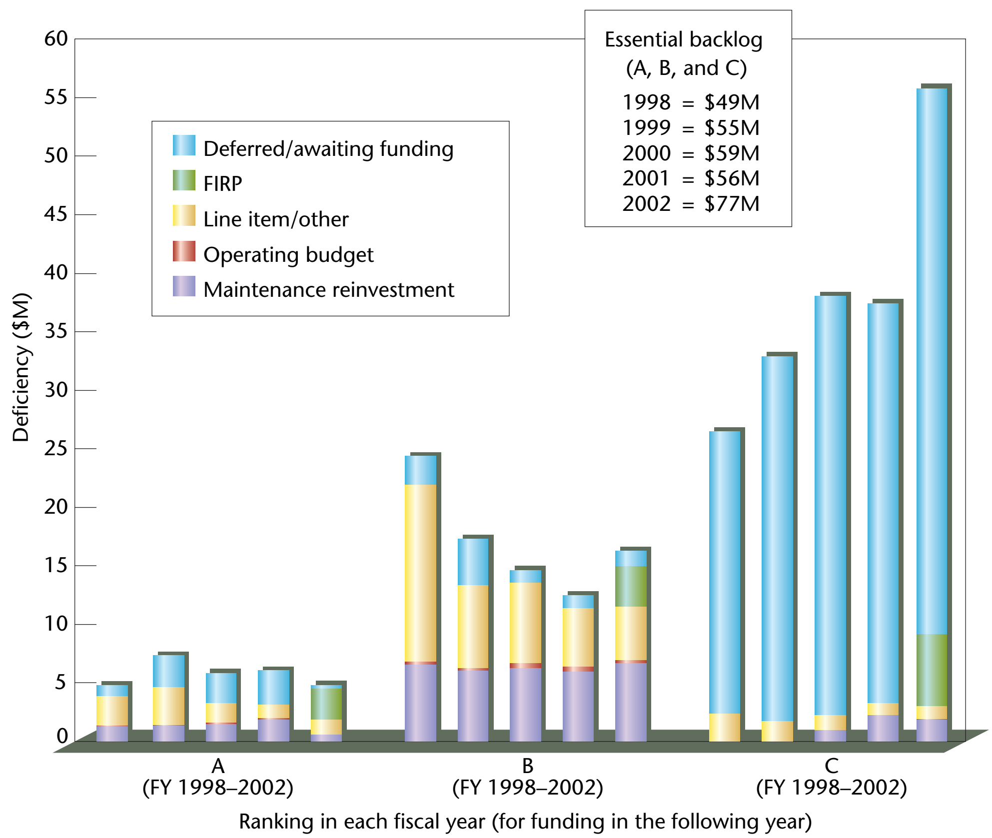


Figure 7. During the five years of maintenance and backlog prioritization, the basic trends on the most critical systems have remained at manageable levels. (These ranking data are presented in the dollars of the fiscal year at the time of prioritization.) As the most critical deficiencies are corrected, the systems that need correction in about three years (C projects) have demonstrated significant growth, reflecting a shift in viewing mission impact from failure to loss of reliability.

The LFC cost profile is evaluated annually to track trends in repair, reinvestment, preventive maintenance, operations, organizational management, and all other investments. During the past five years, the reinvestment process has stabilized repairs, and the annual cost is approaching a nearly constant value that is necessary to maintain the Laboratory's F&I without backlog growth (see Figure 8).

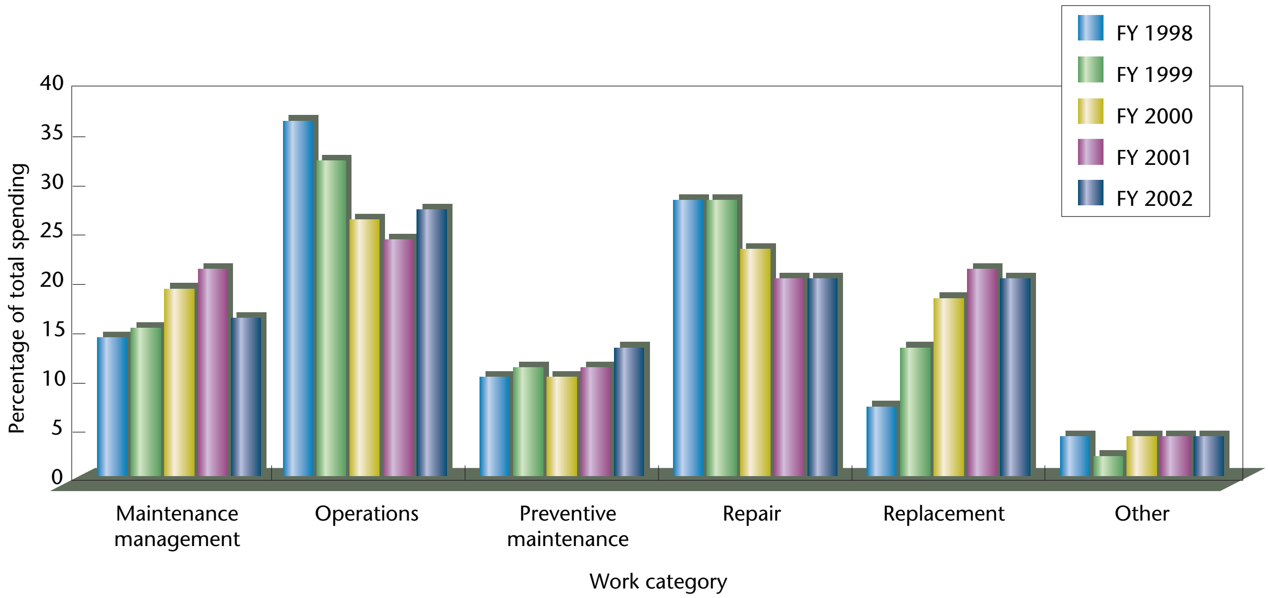


Figure 8. A summary of trends from the maintenance reinvestment effort during the last five years. Efforts to achieve our goal of reducing untimely and expensive repairs by replacing older, unreliable components and systems in the backlog seem to be working.

Windowing

Each year, a multidisciplinary crafts team schedules a "maintenance window" for each Laboratory building. Most low-value (less than $2000) deficiencies and preventive-maintenance requirements are completed during a focused project that also repairs any other unreported deficiencies found during the maintenance window. The CAS is then updated, as appropriate. The cost of a typical repair during the maintenance window averages about $20. In contrast, when a single repair requirement is requested, the cost for the assignment, response, and corrective-action process averages about $120. Thus, our windowing process is credited with eliminating several thousand small work orders (Whiz Tags) each year and saving over $1M per year.

Service agreements

We have created service agreements that establish local management review points for Whiz Tags. These reviews ensure that any provided maintenance is consistent with the requirements and expected life of the larger system. Before a major repair is executed, the task is reviewed at a predetermined cost threshold. If the component is scheduled for replacement in the near future, the repair is scaled back so that service is maintained until the component can be replaced. In the HVAC system area, service agreements with an $800 threshold saved over $1M (20% of the projected budget) in the first year. Service agreements have been developed in FY 2003 for 30 additional system areas. Results will be evaluated over the next year to ensure the cost-effectiveness of the service agreements in each system area.

Facility assessment and ranking system (FAaRS)

To better evaluate the overall condition of the Laboratory's facilities, each building is evaluated annually using 11 categories for the building's mission importance, health or viability, and adaptability for future missions. This evaluation process, known as the facility assessment and ranking system (FAaRS), is an excellent tool for identifying trends that will lead to substandard conditions if corrections are not implemented. Tracking the health of a building (i.e., its age, maintenance backlog, technological obsolescence, and code deficiency assessments) highlights critical opportunities to upgrade an existing facility before the appropriate rehabilitation becomes too expensive.

The Laboratory's FIRP and Maintenance Reinvestment Progress

After five years of investing in backlog stabilization, the Laboratory has substantially eliminated growth in the total maintenance backlog. In late FY 2001, Livermore began applying NNSA FIRP funding to begin reducing the maintenance backlog. The tools developed for the preexisting LLNL reinvestment process were directly applicable. In particular, the modeling tools were of exceptional value for tracking progress and measuring, stabilizing, and reducing the backlog.

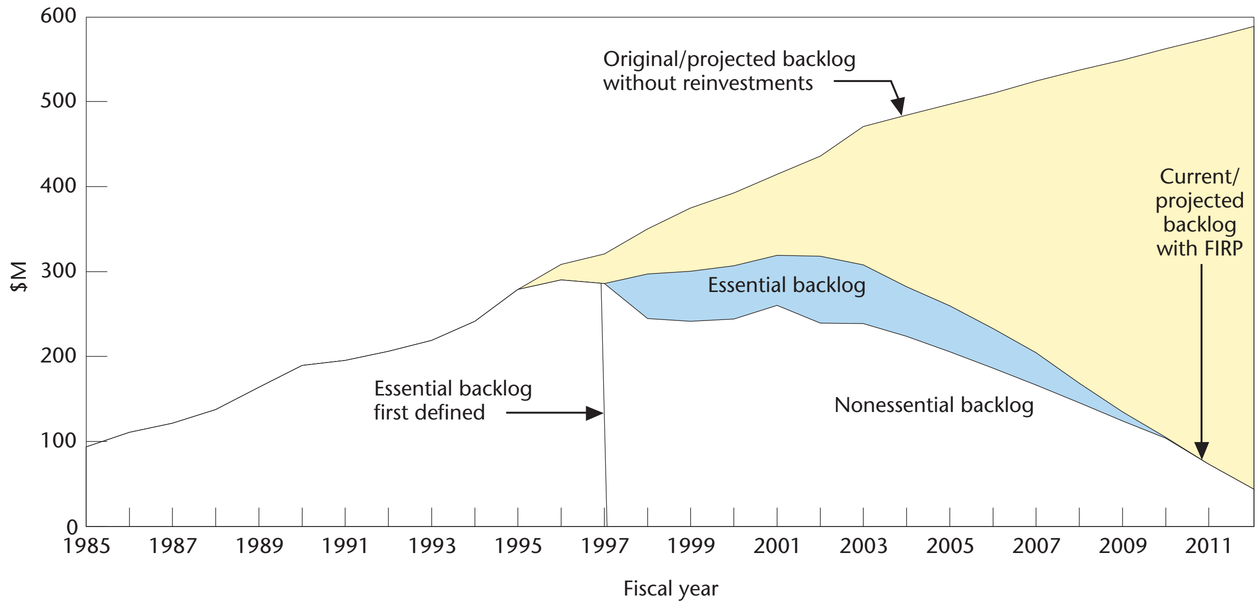
Each FIRP or other reinvestment project has been tracked for schedule and cost-effectiveness. As illustrated in Figures 9a and b, FIRP funding—if continued as projected through FY 2011—will enable LLNL mission-essential facilities to meet industry standards by FY 2009 and will position the Laboratory to maintain this level of quality in the future.

Summary

A long-term and ongoing commitment to develop and apply effective facility management processes has enabled Lawrence Livermore National Laboratory to maintain its mission-critical F&I and establish the level of funding required for doing so in the long run. Historical neglect has left a large maintenance backlog that must be managed; FIRP has provided the necessary funds to solve this complex-wide problem. As discussed earlier in this report, by applying a set of processes that were developed internally or borrowed from other successful government and industrial organizations, Livermore has demonstrated significant progress in stabilizing backlog growth and, with FIRP, predictable reductions in the total backlog over the planned FIRP funding cycle.

The results of this maintenance program have been documented in greater detail in the NNSA/LLNL Ten Year Comprehensive Site Plans. These results show that maintenance and operations is one component of the total site and facility management process that strives to provide appropriate, reliable, and cost-effective F&I to enable the Laboratory to meet its programmatic missions.

(a)



(b)

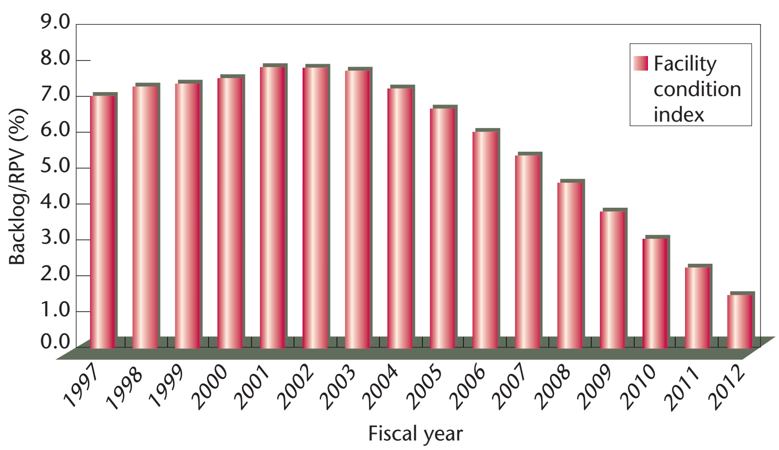


Figure 9. To track maintenance reinvestment progress, the backlog with and without investment was captured and plotted over time. Essential maintenance was tracked as part of the process. Estimates of the following were developed and refined: the growth of new maintenance, the average migration rate of low-priority backlog to a higher priority within the essential maintenance, all sources of funding for future years, projected demolitions, project development, execution costs, burdens, schedules, and any other factor that may impact the management of the maintenance process. (a) The Laboratory's past, present, and projected backlog within the present maintenance reinvestment, Facility and Infrastructure Recapitalization Program funding projections, and any other known sources of funding (e.g., line item, general plant projects, etc.). (b) Livermore's past, present, and projected facility condition index (FCI) scores. (FCI, the ratio of annual backlog projections in [a] to the replacement plant value [RPV] of all Laboratory mission-essential facilities and infrastructure, is an industrial measure of the health of a site's facilities and infrastructure. FCI scores below 5% are in the good industrial practice range; scores below 2% are in the best practice range.)

To analyze the approximately 12,000 deficiencies in the condition assessment survey, several reports are commonly used. One sample report (Figure 2) is used in prioritization. Sample report A-1 summarizes the deficiencies of a specific building, while sample report A-2 captures all of the Laboratory's deficiencies in the work breakdown structure (WBS). (This interim report will incorporate FY 2003 investments and deficiency corrections in September 2003 to define the backlog at the end of the fiscal year.)

Report A-1

Asset Deficiency Detail Report

Asset ID: 111

Defic. No.: 638869 **Rank:** B **Prog. Pri.:** 2 **Mnt. Prob.** H+ **Defic. Owner** MNT **Area:** HVAC
WBS Vol.: 08 **WBS Desc.:** Mech;Cooling;Packaged HVAC **Yr. Completed**
Comp. Desc.: MECH;HVAC UNIT PKGD;(ASSY) **Comp. Service:** CONTINUOUS/ONLINE
Type: HeatPump;Air/Air;SnglPkg; 1.5-5Ton **Location:** ROOF OVER RM. 501M
Qty at Loc.: 1 EACH **Condition:** FAIR **Opt. Yr.:** 2000 **Repl. Qty:** 1 EACH **Backlog Item:** Y
Yr. Installed: 1985 **Equip. ID.:** 111ACHPS01 **Purpose Desc.:** EXCEEDED DESIGN LIFE
Comment: **Defic. Cost:** $10,818

Defic. No.: 638867 **Rank:** C **Prog. Pri.:** 3 **Mnt. Prob.** H **Defic. Owner** MNT **Area:** HVAC
WBS Vol.: 08 **WBS Desc.:** Mech;Cooling;Packaged HVAC **Yr. Completed**
Comp. Desc.: MECH;HVAC UNIT PKGD;(ASSY) **Comp. Service:** CONTINUOUS/ONLINE
Type: HeatPump;Air/Air;SnglPkg; 1.5-5Ton **Location:** ROOF OVER RM. 130A
Qty at Loc.: 1 EACH **Condition:** POOR **Opt. Yr.:** 1995 **Repl. Qty:** 1 EACH **Backlog Item:** Y
Yr. Installed: 1980 **Equip. ID.:** 111ACHPS03-X **Purpose Desc.:** EXCEEDED DESIGN LIFE
Comment: **Defic. Cost:** $10,818

WBS Total $37,459

Defic. No.: 465824 **Rank:** D **Prog. Pri.:** 3 **Mnt. Prob.** M **Defic. Owner** MNT **Area:** HVAC
WBS Vol.: 08 **WBS Desc.:** Mech;Heat+Vent;Air Handlers+Fans **Yr. Completed**
Comp. Desc.: MECH;AIR HANDLERS;HEAT/VENT UN **Comp. Service:** CONTINUOUS/ONLINE
Type: AirHndlr;CentrlSta;Modulr; 5000-10000CF **Location:** ROOM 191
Qty at Loc.: 1 EACH **Condition:** FAIR **Opt. Yr.:** 1989 **Repl. Qty:** 1 EACH **Backlog Item:** Y
Yr. Installed: 1969 **Equip. ID.:** 111ACU02-A(1) **Purpose Desc.:** EXCEEDED DESIGN LIFE
Comment: **Defic. Cost:** $43,634

Defic. No.: 539756 **Rank:** D **Prog. Pri.:** 3 **Mnt. Prob.** M **Defic. Owner** MNT **Area:** HVAC
WBS Vol.: 08 **WBS Desc.:** Mech;Heat+Vent;Air Handlers+Fans **Yr. Completed**
Comp. Desc.: MECH;AIR HANDLERS;HEAT/VENT UN **Comp. Service:** CONTINUOUS/ONLINE
Type: AirHndlr;CentrlSta;Modulr; 5000-10000CF **Location:** ROOM 114A
Qty at Loc.: 1 EACH **Condition:** FAIR **Opt. Yr.:** 2000 **Repl. Qty:** 1 EACH **Backlog Item:** Y
Yr. Installed: 1985 **Equip. ID.:** 111ACU05 **Purpose Desc.:** EXCEEDED DESIGN LIFE
Comment: **Defic. Cost:** $43,634

Defic. No.: 539760 **Rank:** D **Prog. Pri.:** 3 **Mnt. Prob.** M **Defic. Owner** MNT **Area:** HVAC
WBS Vol.: 08 **WBS Desc.:** Mech;Heat+Vent;Air Handlers+Fans **Yr. Completed**
Comp. Desc.: MECH;AIR HANDLERS;HEAT/VENT UN **Comp. Service:** CONTINUOUS/ONLINE
Type: AirHndlr;CentrlSta;Modulr; 5000-10000CF **Location:** ROOM 316F
Qty at Loc.: 1 EACH **Condition:** FAIR **Opt. Yr.:** 2001 **Repl. Qty:** 1 EACH **Backlog Item:** Y
Yr. Installed: 1986 **Equip. ID.:** 111ACU08-5 **Purpose Desc.:** EXCEEDED DESIGN LIFE
Comment: **Defic. Cost:** $43,634

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LLNL WBS Deficiency Backlog Cost Summary

Vol	WBS Description	Assets	Replacement Qty.		Cost Total
01	Fndatns;Excavation,Backfill	3	1,750	CUYD	$158,865
01	Fndatns;Walls	2	3,640	LNFT	$164,437
01	Fndatns;Walls	1	150	S.F.	$8,089
03	Superstr;Stairs;Steel	1	1	EACH	$3,500
03	Superstr;Stairs;Wood	1	35	EACH	$4,273
03	Superstr;Stairs;Steel	19	36	FLIGHT	$539,556
03	Superstr;Roof Str;Wood	15	6,295	LNFT	$126,948
03	Superstr;Floors;CIP Concrete	1		SQFT	$40,023
03	Superstr;Floors;Wood	6	3,660	SQFT	$44,040
03	Superstr;Roof Str;Wood	2	1,700	SQFT	$26,162
04	Ext;Doors	19	53	EACH	$335,189
04	Ext;Windows+ Glazed Walls;Windows	37	1,506	EACH	$2,056,158
04	Ext;Windows+ Glazed Walls;Windows	1	400	L.F.	$766
04	Ext;Doors	1	50	LNFT	$1,324
04	Ext;Doors	1		N/A	$15,000
04	Ext;Paint,Finishes+ Coatings;Conventional	425	2,389,162	SQFT	$9,675,747
04	Ext;Paint,Finishes+ Coatings;Specialty	7	18,004	SQFT	$102,365
04	Ext;Siding;Metal	14	52,888	SQFT	$1,669,141
04	Ext;Siding;Wood & Plastic	105	112,617	SQFT	$1,551,411
04	Ext;Walls;Concrete	1	1,000	SQFT	$33,365
05	Roof;Drainage	6	920	LNFT	$17,535
05	Roof;BU Membrane	92	903,634	SQFT	$38,373,636
05	Roof;Metal	18	96,806	SQFT	$867,519
05	Roof;Shingles	4	34,388	SQFT	$151,073
05	Roof;Single-Ply Membrane	22	94,074	SQFT	$487,540
06	Int;Partitions-Specialty	1	150	EACH	$75,000
06	Int;Paint,Finishes+ Coatings; Conventional	1	65	L.F.	$396
06	Int;Ceilings;Acoustical	13	5,756	SQFT	$26,548

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LLNL WBS Deficiency Backlog Cost Summary

Vol.	WBS Description	Assets	Replacement Qty.		Cost Total
06	Int;Ceilings;Drywall+Plaster	2	568	SQFT	$2,528
06	Int;Floor Finishes;Concrete	23	84,318	SQFT	$44,113
06	Int;Floor Finishes;Resilient	146	624,080	SQFT	$6,214,613
06	Int;Floor Finishes;Tile	3	557	SQFT	$13,945
06	Int;Paint,Finishes+ Coatings; Conventional	314	2,789,557	SQFT	$6,687,623
06	Int;Paint,Finishes+ Coatings;Finishes	1	250	SQFT	$948
06	Int;Paint,Finishes+ Coatings; Specialty	29	71,243	SQFT	$563,413
06	Int;Partitions-Conven;Drywall+Plaster	5	8,211	SQFT	$83,945
06	Int; Wallcoverings;Paneling	1	160	SQFT	$1,969
06	Int;Floor Finishes;Carpet	89	38,234	SQYD	$2,380,298
07	Conveying;Elevators;Hydraulic	12	21	EACH	$3,984,221
08	Mech;Cooling;Cooling Towers	2	2	EA.	$59,304
08	Mech;Cooling;Centrif Chillers	4	6	EACH	$2,583,872
08	Mech;Cooling;Chilled Water Distrib	46	136	EACH	$1,433,738
08	Mech;Cooling;Condenser Water Sys	4	5	EACH	$32,847
08	Mech;Cooling;Condensers	18	37	EACH	$784,831
08	Mech;Cooling;Cooling Towers	1	1	EACH	$3,428
08	Mech;Cooling;Packaged Condensing	69	165	EACH	$3,226,743
08	Mech;Cooling;Packaged HVAC	227	855	EACH	$13,719,060
08	Mech;Cooling;Packaged Reciprocat Chiller	30	56	EACH	$5,010,808
08	Mech;Cooling;Refrig Compressors	5	14	EACH	$38,966
08	Mech;Cooling;Terminal Units	86	249	EACH	$638,261
08	Mech;Fire Prot;Wet Pipe Sprinkler	5	206	EACH	$72,188
08	Mech;Heat+Vent;Air Handlers+Fans	240	2,079	EACH	$31,076,693
08	Mech;Heat+Vent;Boilers	26	47	EACH	$3,657,931
08	Mech;Heat+Vent;Ductwork	46	259	EACH	$811,201
08	Mech;Heat+Vent;Fuel Oil	1	1	EACH	$11,830
08	Mech;Heat+Vent;Heating Hot Water Distr	146	651	EACH	$1,264,785

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LLNL WBS Deficiency Backlog Cost Summary

Vol	WBS Description	Assets	Replacement Qty.		Cost Total
08	Mech;Heat+Vent;Hot Air Furnaces	62	146	EACH	$471,853
08	Mech;Heat+Vent;Steam Distr,Condens Retur	2	2	EACH	$3,342
08	Mech;Heat+Vent;Terminal Units	21	354	EACH	$746,906
08	Mech;Plumbing; Compressed Air	15	109	EACH	$1,942,422
08	Mech;Plumbing;Domestic Water	91	462	EACH	$3,708,564
08	Mech;Plumbing;Drain,Waste,Vent	5	358	EACH	$83,962
08	Mech;Plumbing;Natural Gas	1	295	EACH	$888,035
08	Mech;Special Sys;Drinking Water Sys	3	29	EACH	$53,677
08	Mech;Cooling;Terminal Units	1	85	LB.	$100,000
08	Mech;Cooling;Chilled Water Distrib	1	100	LNFT	$23,396
08	Mech;Fire Prot;Wet Pipe Sprinkler	1	6,700	LNFT	$424,290
08	Mech;Heat+Vent;Air Handlers+Fans	1	250	LNFT	$9,348
08	Mech;Heat+Vent;Ductwork	3	5,301	LNFT	$3,553,033
08	Mech;Heat+Vent;Heating Hot Water Distr	2	460	LNFT	$54,038
08	Mech;Plumbing;Drain,Waste,Vent	3	880	LNFT	$59,284
08	Mech;Plumbing;Natural Gas	2	320	LNFT	$15,398
08	Mech;Cooling;Packaged HVAC	1	26	N/A	$13,000
08	Mech;Plumbing;Domestic Water	1	13,212	N/A	$50,000
08	Mech;Plumbing System All Inclusive	10	214,583	SQFT	$1,516,507
08	Mech;Cooling;Cooling Towers	8	16,027	TON	$6,725,324
09	Elec;Lighting;Luminaires	124	5,116	EACH	$2,666,840
09	Elec;Serv+Distrib;Low Voltage Distrib	212	2,247	EACH	$27,803,383
09	Elec;Serv+Distrib;Med Voltage Distrib	15	467	EACH	$16,001,995
09	Elec;Spcl;Control Units	3	34	EACH	$801,934
09	Elec;Spcl;Generators,Standby+Emergency	22	29	EACH	$2,531,646
09	Elec;Serv+Distrib;Low Voltage Distrib	63	250,589	LNFT	$4,064,401
09	Elec;Serv+Distrib;Med Voltage Distrib	1	60,518	LNFT	$824,609
09	Elec;Spcl;Signal Circuits	13	13	N/A	$1,140,000

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LLNL WBS Deficiency Backlog Cost Summary

Vol	WBS Description	Assets	Replacement Qty.		Cost Total
09	Electrical System	1	1	N/A	$35,000
09	Electrical System	91	2,041,259	SQFT	$47,970,311
11	Spclty Sys;Tanks;Ground Level	2	15	EACH	$92,132
12	Site;Roads+Walks	1	1	EA.	$30,221
12	Site;Utlty Dist; Cool;Chill Water Distrib	1	1	EACH	$20,516
12	Site;Utlty Dist;Elec Infa; Steel Tower+Pole	1		EACH	$149,019
12	Site;Utlty Dist;Elec Infa;Wood Poles	1	314	EACH	$2,615,704
12	Site;Utlty Dist;Plumb;Gas Distrib Sys	1	258	EACH	$557,029
12	Site;Utlty Dist;Plumb;Sewer+Drain Collect	2	135	EACH	$517,909
12	Site;Utlty Dist;Plumb;Water Distrib Sys	5	643	EACH	$4,669,775
12	Site;Utlty Dist;Plumb;Water Treat Plant	1	1	EACH	$75,000
12	Site;Roads+Walks	1	1,000	LNFT	$60,842
12	Site;Security Gates+Fences	1	13,060	LNFT	$1,476,803
12	Site;Utlty Dist; Cool;Chill Water Distrib	1	1,200	LNFT	$302,655
12	Site;Utlty Dist;Plumb;Gas Distrib Sys	3	137,959	LNFT	$41,662,466
12	Site;Utlty Dist;Plumb;Sewer+Drain Collect	2	26,975	LNFT	$1,465,696
12	Site;Utlty Dist;Plumb;Water Distrib Sys	3	80,697	LNFT	$10,962,569
12	Site;Landscaping	1	4,400	N/A	$25,000
12	Site;Utlty Dist;Plumb;Gas Distrib Sys	1	1	N/A	$320,000
12	Site;Utlty Dist;Plumb;Sewer+Drain Collect	2	15,590	N/A	$3,257,000
12	Site;Utlty Dist;Plumb;Water Distrib Sys	2	7	N/A	$2,804,000
12	Site;Fountains+Pools	1	7,500	SF SURF	$1,058,168
12	Site;Roads+Walks	2	120	SQFT	$5,672
12	Site;Landscaping	2	900	SQYD	$219,284
12	Site;Roads+Walks	5	485,463	SQYD	$7,712,942
				TOTAL BACKLOG :	$345,302,608*

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*Mid-year total without correction for ongoing annual investments